ARMORED FORCE
MEDICAL RESEARCH LABORATORY

FORT KNOX, KENTUCKY

Report On

GUN FUME HAZARD FROM 37 MM GUN IN M5 LIGHT TANK

Project 3-2

February 18, 1943

ARMORED FORCE MEDICAL RESEARCH LABORATORY
Fort Knox, Kentucky

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REPORT ON GUN FUME HAZARD
FROM
37Mm GUN IN M5 LIGHT TANK

1. PROJECT: Determination of the Characteristics and Effects Upon the Crew of Gun Fumes from Firing of the Weapons in Tanks of the M-5 Series.

a. Authority - Letter Commanding General, Headquarters Armored Force, Fort Knox, Kentucky, 400.112/6 GNOHD, dated September 24, 1942.

b. Purpose - To determine the extent of the hazard from fumes released in firing the 37 Mm gun in the M-5 light tank.

2. DISCUSSION:

a. Methods -

(1) Fire Pattern: Five bursts of 10 rounds; five seconds between rounds and 5 minutes between bursts.

(2) Tank operation: Tank buttoned-up and engine operated at its normal idling speed. Full crew in tank. Wind from the rear.

(3) Ammunition: 37Mm AP M51 FNH M2

3. CONCLUSIONS:

a. Under the conditions of test, carbon monoxide concentrations exceeded slightly the maximum acceptable level of 0.05%

b. There was no accumulation of carbon monoxide from one burst to another.

c. Concentrations of ammonia were not high enough to cause eye irritation.

d. Concentrations of oxides of nitrogen were well within the acceptable limit.

e. Increased blood concentrations of carbon monoxide did not exceed 7.4 percent in any crew member during a 25 minute period of exposure.

f. Control of 37Mm gun fumes in the M-5 light tank is acceptable.

4. RECOMMENDATIONS:

a. So long as the basic ventilation in the M-5 light tank is not changed, further consideration of the gun fume problem is unnecessary.

b. This tank should not be fired with the tank engine dead unless the turret hatch is opened.

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#1-Appendix I, Sampling and Analysis
#2-Appendix II, with Tables I and II and
Figure I.

APPENDIX I

SAMPLING AND ANALYSIS

1. Carbon Monoxide.

a. Collection of air samples: Three methods were employed.

(1) The Mine Safety Appliances continuous indicator.
(2) Instantaneous samples in evacuated flasks for the determination of peak concentrations and clearance rates at the end of firing.

(3) Continuous samples in evacuated flasks, sampling being continued at a constant rate throughout a given test in order to determine the average concentration for a given condition. Samples were collected in this manner at one or more crew positions.

b. Blood samples for the determination of carbon monoxide content were obtained from the tank crew members in the standard manner before and at the end of all complete tests. They were not obtained in exploratory tests.

c. CO Analysis: Evacuated flask samples were analyzed by the iodine pentoxide method and blood samples by the Scholander-Roughten and Spectro Photometric methods. The MSA CO indicator was checked at regular intervals against known air-CO mixtures.

2. Concentrations of ammonia and oxides of nitrogen were determined in portions of the instantaneous flask samples, employing the Nessler and phenoldisulphonic acid procedures respectively.

APPENDIX II

Concentration of carbon monoxide generated in the M-5 light tank during the firing of the 37Mm gun, with the fire pattern described in the body of this report, are given in Table I and are shown graphically in Figure I. Increase in blood concentrations of CO after 25 minutes exposure are presented in Table II. Concentrations of ammonia and oxides of nitrogen did not exceed 40 and 10 ppm. respectively.

TABLE I

CONC. OF CARBON MONOXIDE
FROM
37Mm GUN IN M-5 LIGHT TANK

After 1st Burst - (9 rds), Loader	0.09
After 2nd Burst - (10 rds), Loader	0.173
After 3rd Burst - (10 rds), Loader	0.250
After 4th Burst - (10 rds), Loader	0.206
After 5th Burst - (6 rds), Loader	0.063

Cont. Sample - Loader	0.063
Cont. Sample - Gunner	0.053

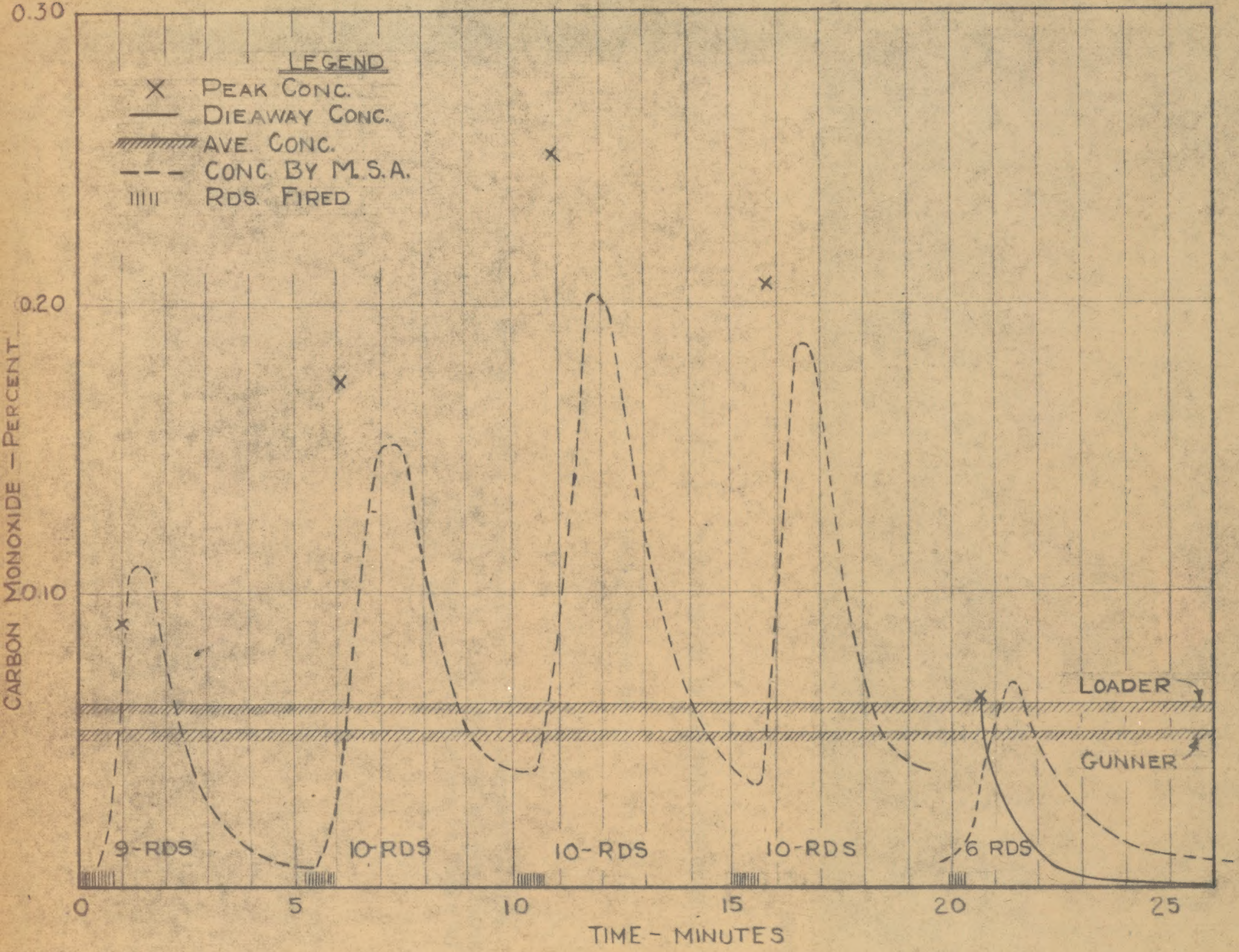
Clearance Rate after last burst -------------------------20 Sec.
(Time for Conc. to decrease 50%)

TABLE II

CARBON MONOXIDE CONCENTRATIONS IN BLOOD OF CREW MEMBERS

(25 MINUTES EXPOSURE)

CREW MEMBER	CO Hemoglobin as % of Total Pigment			% CO in Air From Continuous Samples
	Before Exposure	After Exposure	Increase	
Loader	4.2	11.6	7.4	0.063
Gunner	7.4	11.0	3.6	0.053
Driver	1.8	2.6	0.8	-
Asst. Driver	6.0	6.9	0.9	-



CARBON MONOXIDE CONCENTRATIONS 37 M.M. GUN • M-5 LIGHT TANK

FIG I